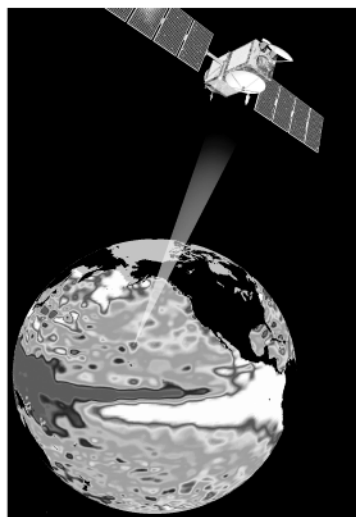


Mapping the Oceans



Unless you spend a lot of time at sea—or flying over it—it's hard to keep in mind that far more of our planet is under water than above water. It's also hard to imagine that the deepest parts of the ocean are far deeper than the highest mountains are high. But it's true! That's a lot of salt water.

A Big Energy Transport System

In addition to all the seaweed, fish, and whales that call all this water their home, the oceans also hold a huge amount of heat. The top 3 meters (about 10 feet) of the ocean contains as much heat energy as the whole atmosphere of Earth (which extends up hundreds of miles).

The water in the world's oceans isn't all the same temperature. In some places, like near Earth's equator, the water soaks up a lot of heat energy from the Sun. In other places, like near the North and South Poles, the water cools off, since not much direct sunlight reaches those places.

Since water flows easily, it moves all around Earth, picking up heat in one place and carrying it someplace else. Moving heat energy in the oceans and atmosphere are the primary causes of weather. Thunderstorms, rain, snow, wind, hurricanes, droughts, hot weather, freezing weather—in a very complicated way the oceans are in charge of them all. For example, "El Niño" is what we call the condition when a lot of warm water gathers in one place in the Pacific Ocean and causes unusual weather in many places all over the world. (See Panel 9 on this poster.)

Because the oceans are so important and so enormous, we use spacecraft in orbit around Earth, as well as ships and buoys, to collect information.

Global Weather Spies in the Skies

To understand weather, we have to understand the oceans and how they move heat around the Earth. Jason-1 is a new Earth-orbiting spacecraft to study the oceans. It was launched December 2001. It continues and expands the data that has been collected by the TOPEX/Poseidon spacecraft, which since 1992 has been orbiting Earth at an altitude of over 1300 kilometers (800 miles).

Jason-1 and TOPEX/Poseidon use *altimeters* (al-TIM-uh-ters) to measure the height of the ocean surface. As the spacecraft flies over an ocean, the altimeter sends microwave signals down to the surface of the water. The signals bounce off the water and back up to the spacecraft. By measuring how long it takes for the signals to bounce back and by precisely measuring the locations of the spacecraft, the altimeter can determine the height of the ocean's surface at that point. Using this information, scientists can create very detailed maps of the ocean surfaces all around the world. Warmer water expands a bit, making the ocean surface higher. Where Jason-1 detects a rise in the ocean surface of 1 centimeter (4/10 inch), the top 50 meters (164 feet) of ocean is 1 degree Celsius (1.8 degrees Fahrenheit) warmer than the surrounding water.

These ocean "hills and valleys" tell us how the heat is moved around the oceans. Large amounts of heat moving from one place to another can affect the weather. More evaporation comes from hot water than from cold water, so with hot water comes increased rainfall. In the Gulf of Mexico, people watch the movement of warm eddies very carefully, because if a hurricane goes over one of these warm eddies, the wind speeds in the hurricane can get even faster!

Jason-1, along with other ocean-observing spacecraft, will help us understand how the oceans change over time and how those changes affect the weather and climate everywhere on Earth.

To learn more:

El Niño: Stormy Weather for People and Wildlife, by Caroline Arnold. Houghton-Mifflin, 1998.

The Jason-1 spacecraft: <http://sealevel.jpl.nasa.gov/mission/jason-1.html>

Oceanography: <http://sealevel.jpl.nasa.gov/education/education.html>

A fun activity about the El Niño condition and how it affects weather:
http://spaceplace.nasa.gov/topex_make1.htm

An interesting classroom activity about how the Global Positioning System satellites work to enable Jason-1 always to know exactly where it is:
http://spaceplace.nasa.gov/teachers/jason_gps.pdf

NASA Space Link, a comprehensive electronic library of information related to NASA's aeronautics and space research: <http://spacelink.nasa.gov>

NASA's Earth Science Enterprise: <http://www.earth.nasa.gov>